Office of
Transportation Technologies

OTT brings new NO_x-reducing process to market

With other breakthroughs soon to follow from private-sector start-ups

A process developed at the Office of Transportation Technologies (OTT) laboratories in the mid-1980s is the basis for a new onboard exhaust treatment system that can help America's truck and bus fleets reduce their emissions of acid rain-causing nitrogen oxide (NO_x) by up to 90 percent or more, while simultaneously eliminating up to 80 percent of the small lung-burning particulates endemic to diesel exhaust. This revolutionary advance in exhaust after treatment is the result of a win-win public-/private-sector partnership, with OTT providing basic science and cost-shared funding to an entrepreneurial private- sector company that invested its resources to drive the effectiveness and practicality of the process to ultimate marketability. In this synergistic environment, a modest public investment has led to a product that can help truck and bus fleets meet the most stringent clean air requirements, safeguarding the health of our nation, while creating an industry that is projected to create several hundred jobs in the short term.

Partners drive new science from laboratory demo to commercial viability. The commercial process–called the Advanced NO_xTECH system–is roughly based upon Federal laboratory-scale research performed at the Sandia National Laboratories in the 1980s. Challenged by DOE to develop a means to rapidly reduce the emission of nitrogen oxides in diesel exhaust, a team led by researcher Bob Perry developed the RAPRENOX process, a patented scientific breakthrough. Perry was given the rights to the basic process, which he later transferred to Cummins Engine Company. With OTT assistance, Cummins performed years of cutting-edge R&D in making the breakthrough process commercially practical. Recently, management and members of the development team bought the rights to the evolving process, and formed a company, Noxtech Inc., targeting the Advanced NO_xTECH system to fleet operators, as well as to those utilizing the system for stationary applications such as power generation.

The basic concept behind the technology is to inject a chemical into the exhaust and drive a reaction that breaks NO_x down into benign constituent elements by use of high temperature rather than a chemical catalyst. According to Noxtech Inc. General Manager Ralph Slone, the R&D work that transformed RAPRENOX into the Advanced NO_xTECH system was focused in two key areas–reducing chemical costs and reducing the size and power drain of the reactor needed to create the required temperature. The commercialized Advanced NO_xTECH system utilizes a small reactor about the size of a muffler that creates a fuel penalty of less than 5 percent, yet is capable of sustaining the 1400° F required.

Just as importantly, intensive investigation also led to the development of an inexpensive, nontoxic liquid chemical replacing the more expensive powdered chemical demanded by the original RAPRENOX process. In addition to the cost-savings attributable to the raw material, use of a liquid rather than a powder allowed significant system simplifications, generating further cost-reductions and making the system even more practical for commercial use.

In addition to effectively removing most of the NO_x, the reaction also degenerates most of any unburned hydrocarbons present, and the creation of the "hot chamber" allows the burn-off of a majority of the diesel particulates, often eliminating the need for a stand-alone particulate trap or other device.

Cleaner air—and a boon to America's diesel-enhanced economy. Years of research, according to Slone, have led to a cost-effective, all-in-one method of generating a very clean exhaust, at a time when America's truck and bus fleets, as well as the general public, need it the most.

Diesel fleets are vital to getting goods to geographically diverse markets quickly and cost-effectively, and fleet operators working to meet state and Federal emissions regulations are studying all available technologies and often need to make hard choices balancing emissions levels, vehicle performance and cost. It is believed that retrofit of an Advanced NO_xTECH system will allow operators to meet their emissions goals with minimal impact on the success of their operations and the jobs dependant upon it.

The Advanced NO_xTECH system could also go a long way toward helping all American cities improve the breathability of their air. For example, the American Lung Association estimates that if all areas of the country were to meet the strict California standards for particulate matter concentration, nearly 2,000 premature deaths and 37,000 emergency room visits could be avoided each year, and nearly $11 billion in health-care costs and lost productivity could be regained.

Next generation soon to follow. At the same time as the Advanced NO_xTECH system was being developed, Noxtech Inc. and OTT were already working on a new commercial system that is potentially even more practical and effective in cleaning diesel exhaust. The Plasma Assisted Catalyst System is the result of a partnership enabled by OTT between Noxtech Inc. and AEA Technology plc, an innovative British company recently spun-off from an energy agency in the United Kingdom.

OTT, along with California's South Coast Air Quality District, has supported and sponsored the partners' development of a system that demonstrates in laboratory tests a 90 percent reduction rate for both NO_x and particulates with no onboard chemicals or heating needed. The system uses a small amount of electricity from the engine to generate a nonthermal plasma on a ceramic surface, enabling the reaction.

According to Slone, the relative simplicity and low cost of the system expand its potential markets to include all mobile applications, not only trucks and buses, but also the family car. It is hoped that the system would ultimately become standard equipment in automobiles, further helping improve air quality in locations around the country. Commercial prototypes are expected by 1997, with commercialization to follow, possibly as soon as 1999.

Federal government provides vital support for a breakthrough product that can help America meet its goals. OTT is chartered with helping industry develop practical solutions to transportation issues that will help America achieve its clean air and energy security goals, leveraging modest public investment to support private-sector innovation.

"We've invested more than $20 million in the Advanced NO_xTECH system, much more than OTT's funding of course, but the OTT funds were always provided at critical junctures, and went a long way toward convincing senior management of the ultimate achievability of this vision," noted Slone. "In addition, our people visited OTT facilities informally throughout the development process, and tapped into several areas of technical expertise they had that we didn't. Without OTT support, we would not have been able to drive the original RAPRENOX process into a commercially viable product."

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